Copy for the designated Office (US) PCT/GB00/02137

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

BOULT WADE TENNANT
Verulam House
70 Gray's Inn Road
London WC1X 8BT
ROYAUME-UNI

Date of mailing (day/month/year)	IMPORTANT NOTIFICATION
18 January 2001 (18.01.01)	
Applicant's or agent's file reference 53034/001	
International application No. PCT/GB00/02137	**International filing date** (day/month/year) 02 June 2000 (02.06.00)

1. The following indications appeared on record concerning:

☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
BOULT WADE TENNANT Verulam House 50 Gray's Inn Road London WC1X 8BT United Kingdom		
	Telephone No. 44 0 20 7430 7500	
	Facsimile No. 44 0 20 7831 1768	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address	State of Nationality	State of Residence
BOULT WADE TENNANT Verulam House 70 Gray's Inn Road London WC1X 8BT United Kingdom		
	Telephone No. 44 0 20 7430 7500	
	Facsimile No. 44 0 20 7831 1768	
	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☐ the International Preliminary Examining Authority
☒ the designated Offices concerned
☐ the elected Offices concerned
☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer R. Raissi
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/306 (March 1994) 003783595

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 15 January 2001 (15.01.01)	
International application No. PCT/GB00/02137	**Applicant's or agent's file reference** 53034/001
International filing date (day/month/year) 02 June 2000 (02.06.00)	**Priority date** (day/month/year) 04 June 1999 (04.06.99)
Applicant WATLING, David	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

17 November 2000 (17.11.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Jean-Marc Vivet
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

BOULT WADE TENNANT
Verulam House
50 Gray's Inn Road
London WC1X 8BT
GRANDE BRETAGNE

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	10.10.2001
Applicant's or agent's file reference 53034/001	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/02137	02/06/2000	04/06/1999

Applicant
BIOQUELL UK LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/
European Patent Office
D-80298 Munich
Tel. +49 89 2399 - 0 Tx: 523656 epmu d
Fax: +49 89 2399 - 4465

Authorized officer
Ipinazar, P
Tel.+49 89 2399-8131

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
53034/001		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 00/ 02137	02/06/2000	04/06/1999
Applicant		
MICROFLOW LIMITED		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

   [ ] the text is approved as submitted by the applicant.

   [X] the text has been established by this Authority to read as follows:

   SEALED ENCLOSURE STERILIZATION

5. With regard to the **abstract**,

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/02137

CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61L2/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 99 30747 A (ROSSI & CATELLI SPA ;MUSATTI MARCO (IT); CATELLI CAMILLO (IT)) 24 June 1999 (1999-06-24) page 6, line 11 -page 10, line 2	1-12
A	US 4 952 370 A (CUMMINGS ARTHUR L ET AL) 28 August 1990 (1990-08-28) column 2, line 41 - line 64	1,7
A	DE 44 27 577 A (KRONSEDER MASCHF KRONES) 8 February 1996 (1996-02-08) abstract	1,7

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 September 2000	19/09/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Diederen, J

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 00/02137

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9930747 A	24-06-1999	DE 19808318 A	02-09-1999
		IT MO970225 A	14-06-1999
		AU 1031999 A	15-09-1999
		AU 1782299 A	05-07-1999
		WO 9943607 A	02-09-1999
US 4952370 A	28-08-1990	CA 1318479 A	01-06-1993
		DE 68908857 D	07-10-1993
		DE 68908857 T	20-01-1994
		EP 0373201 A	20-06-1990
		JP 2750764 B	13-05-1998
		JP 3500017 T	10-01-1991
		WO 8910762 A	16-11-1989
DE 4427577 A	08-02-1996	NONE	

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
53034/001		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/02137	02/06/2000	04/06/1999
International Patent Classification (IPC) or national classification and IPC A61L2/20		
Applicant BIOQUELL UK LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 9 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☒ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
17/11/2000	10.10.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Semino, D Telephone No. +49 89 2399 7324

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/02137

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

5-9	as originally filed			
1-4,4a	as received on	30/07/2001	with letter of	27/07/2001

Claims, No.:

1-12	as received on	30/07/2001	with letter of	27/07/2001

Drawings, sheets:

1/1	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)
   see separate sheet

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	2-6
	No:	Claims	1,7-12
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-12
Industrial applicability (IA)	Yes:	Claims	1-12
	No:	Claims	

2. Citations and explanations
   see separate sheet

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

   see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item I
Basis of the report

1. The following amendments have been considered to go beyond the disclosure as filed (Article 34(2)(b) PCT):

a. the addition of the word 'carrier' to define the gas on line 4 of claim 1, since no basis for such a wording can be found in the original application (a basis can be found only for specific gases);

b. the expression 'decontaminant gas/water vapour mixture' since it can have both the meaning 'a mixture of a decontaminant gas and water vapour' and 'a vapour mixture of decontaminant gas and water', leading in both cases to unclarity problems (see also Item VIII below);

c. the addition of the expression 'and controlling the introduction of said vapour mixture in accordance with conditions determined in the enclosure' on lines 12-14 of claim 1 and of the corresponding expression on lines 30-32 of claim 7, since no basis can be found in the original application concerning the possibility of controlling in accordance with **any** conditions in the enclosure, but only according to specific measurements and specific variables.

2. Since most of the amendments of the independent claims are not allowable and/or unclear, the present report has been established for the original claims as filed.

Re Item V and VIII

1. Independent claims 1 and 7 do not satisfy the requirements of Article 6 PCT as to clarity for the following reasons:

i. it is not clear what is intended by '**the** gas' (claim 1, l. 4), no gas being previously mentioned, and if and how it differs from 'a decontaminant gas' (l. 6);

ii. it is not clear what is meant by 'a decontaminant gas' in the whole context of claim 1, no **condensation of a gas** being possible by means of temperature variation (only a vapour can condense in such conditions);

iii. following the two points above, it is not clear which is the composition of the flowrate fed to the sealed enclosure and whether the mentioned 'dew point' (l. 7) refers to the dew point of water or of a vapour mixture;

iv. it is not clear which are the features of the 'preparation region' (cf. l. 5), which

could make it distinguishable from any feed conduit for the sterilising composition;

v. as far as claim 7 is concerned and in additions to the objections under points i-iv, it must be considered that a novel use of a known apparatus cannot make the apparatus novel as long as the known apparatus is **suitable** for the novel use; as a case in point, it can be noted that the limitation on lines 20-24 does not add anything to the means for dispensing water vapour, any such means being suitable to provide a concentration above a desired dew point.

2. As long as the sterilising mixture is intended to comprise a mixture of vapours of hydrogen peroxide and water and the preparation region is intended as a feed conduit including a vaporiser, the method of claim 1 is anticipated by the disclosure of D1 (US-A-4952370), which describes (cf. claim 1 and figures) a process for the sterilisation of surfaces within a closed chamber comprising the steps of introducing a vapour phase containing hydrogen peroxide and water in the chamber, contacting the surfaces with the vapour phase so as to effect condensation and applying a source of vacuum while continuing to introduce the vapour phase until sterilisation is completed. Moreover, the temperature is monitored so as to maintain the surfaces at desired values and the pressure is monitored as well and controlled by the source of vacuum (control of temperature and pressure is equivalent to control of the desired level of condensation that takes place in the chamber).
The method of claim 1 is therefore not novel (Article 33(2) PCT).

3. The apparatus of claim 7 is similarly not novel (Article 33(2) PCT), since it is anticipated by D1 (a valve is a means for controlling the dispensing of a flowrate and pressure and temperature measurements are means for monitoring temperature and degree of condensation, cf. also par. 1.v).
Further the apparatus of claim 7 is also anticipated by the apparatuses disclosed in D2 (EP-B-0486623, cited in the application, cf. claims 1-4 and Figure 1) and D3 (GB-A-2308066, cited in the application, cf. claim 1 and Figure 1), where, despite of the fact that condensation is not desired, all apparatus features necessary to monitor and control condensation and to feed and treat the sterilising composition are present (cf. par. 1.v).

4.1 The apparatuses of dependent claims 8-12 are also not novel (Article 33(2) PCT),

the additional features being disclosed in at least one of D1-D3.

4.2 Dependent claims 2-6 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step (Article 33(3) PCT), the additional features being common in the field.

5. The application does not fulfill the requirements of Article 6 PCT also for the following reasons:

i. the objection under paragraph 1.ii also applies to claims 5 and 11;

ii. the wording of claim 11 (cf. 'formulating (?) supply' and repetition of the expression 'after a sufficient amount ...') is such as to make it unclear which are the additional apparatus features, which are claimed;

iii. it is not clear what is meant by the sentence on page 4, l. 13-16, i.e. what is a 'correct vapour pressure characteristic' and which components can be defined by such an expression; moreover, it is not clear from the whole of the description where the hydrogen peroxide is inserted into the sterilising apparatus.

Re Item VI

Certain published documents (Rule 70.10)

Application No Patent No	Publication date *(day/month/year)*	Filing date *(day/month/year)*	Priority date *(valid claim)* *(day/month/year)*
WO-A-9930747	24.06.1999	10.12.1998	12.12.1997

IMPROVEMENTS IN OR RELATING TO A METHOD OF STERILIZING A SEALED ENCLOSURE

The present invention relates to decontamination and sterilisation systems and more particularly to the control of gaseous decontamination and systems where the vapour has more than one component.

Conventional gas sterilisation and decontamination systems have been designed in order to avoid condensation, and as such both flow through and recirculating systems have been so organised as to keep the vapour concentrations, especially of water, below the dew point. Examples of such systems are described in European Patent EP0486623B1, UK Patent 2 217 619 B, WO 89/06140 and UK Patent application GB 2308 066 A.

US-A-4952370 A discloses a method for sterilizing the interior of a chamber using hydrogen peroxide in which a first portion of the surfaces within the chamber is at a temperature below 10°C and a second portion of the surfaces is at a temperature greater than 10°C. The process includes the step of introducing vapour phase hydrogen peroxide to the chamber, contacting the first portion with the vapour to effect condensation thereon, contacting the second portion with the vapour, applying a source of vacuum to the chamber and continuing to introduce vapour phase hydrogen peroxide into the chamber until the surfaces are sterile whilst preserving the temperature ranges of the first and second portions.

More recent work has shown that for rapid surface sterilisation and decontamination in rooms and smaller chambers, or isolators, condensation of a mixture of vapours of a gaseous decontaminant such as hydrogen

peroxide and water is essential.

The object of the present invention is to control the sterilisation and decontamination systems both for closed recirculating systems, flow through systems and systems which use recirculation with a proportion of the recirculation air or air/gas mixture being exhausted from the closed system so that condensation may occur rapidly, evenly and controllable through the area to be sterilised or decontaminated.

For the purpose of this patent the term decontaminate shall in future include both chemical and microbiological decontamination. Microbiological decontamination shall mean the reduction of the viable bioburden, which is generally described either as sterilisation, sanitation or disinfection.

This invention provides method of sterilizing a sealed enclosure comprising the steps of circulating a carrier gas through the enclosure and through a preparation region, dispensing a decontaminant gas/water vapour mixture into the circulating gas in the preparation region to flow therewith through the enclosure to reach a concentration in the enclosure above the dew point of the gas/water vapour mixture for the ambient temperature in the chamber and thereby to condense onto surfaces in the enclosure to sterilise such surfaces and controlling the introduction of said vapour mixture in accordance with conditions determined in the enclosure; wherein the gas temperature in or exiting the enclosure or entering the preparation region, decontaminant gas concentration in or exiting the enclosure or entering the preparation region and condensation of the decontaminant gas in the enclosure are monitored, and the dispensing of the decontaminant gas/water vapour into the gas in the

preparation region is controlled in response to the levels determined by said monitoring to provide a requisite level of condensation of the decontaminant gas/water vapour in the enclosure.

The term "sealed enclosure" shall include any chamber or room that may for practical purposes be sealed so as to prevent the escape of such amounts of active gas as to cause a hazard.

The sealed enclosure is connected to a means of processing by two pipes through which air or a mixture of air and gases, where the gases are hydrogen peroxide and water vapour, may circulate. The air or mixture of air and gases being delivered from the means of processing to the sealed enclosure to then be returned to the processing means or alternatively a flow through system where the air or air/gas mixture is vented from the sealed enclosure in a safe manner. The air or mixture of air and gases on entering the means of processing may, if necessary, first pass through a system of purification to remove and make safe any gases within the mixture of air and gases. This purification process will not normally be required because of the stability of the gas mixture. Hydrogen peroxide gas has been shown to be stable in the homogenous vapour phase at ambient and temperatures below 300°C. Decomposition will occur on surfaces but only at insignificant rates on those surfaces generally found in clean rooms and isolators. High rates of decomposition will occur on certain organic substances such as micro-organisms but as the quantity of these materials is very small the total amount of decomposition is also very small, and hence does not significantly affect the gas concentration. A fan or pump or compressor is then used

to propel the air or mixture of air and gases around the system, and drive the fluid through the evaporation chamber where additional gases are added to the air or air gas mixture. The enriched air/gas mixture is then passed through the connection from the processing means to the sealed chamber.

The function of the air/gas mixture in the sealed chamber is to decontaminate the surfaces of the chamber.

Similar systems have been employed for some time for the surface sterilisation of sealed enclosures, but in these applications it has always been considered important to avoid condensation, Patent EP 0 486 623 B1 specifically sets out a table of operation to avoid condensation. The present invention sets out a method of decontamination by micro condensation and provides for a method of control. It has been established that faster and more reliable surface decontamination may be achieved if micro condensation is encouraged and controlled. The dew point of any hydrogen peroxide and water vapour mixture may be ascertained from the activity coefficients for the gases, and by using a combination of dew point data, the actual dew point within the sealed chamber and the temperature it is possible to calculate the concentration of hydrogen peroxide in the condensate.

A knowledge of the condensation parameters, and the amount of condensation allows a prediction of the time at which surface decontamination will occur. For such a system to function reliably it is also essential that there is very good distribution of gas within the sealed enclosure.

The active gas in such micro-condensation systems used for decontamination is not limited to hydrogen peroxide but includes a gas or mixture of gases that exhibits the correct vapour pressure characteristics.

The invention also provides a apparatus for sterilizing a sealed enclosure comprising means for circulating a gas through a preparation region and through the enclosure and means in the preparation region for dispensing a decontaminant gas and water vapour mixture into the circulating gas to flow therewith through the enclosure to reach a concentration in the enclosure above the dew point for the ambient temperature in the chamber and thereby to condense onto surfaces in the enclosure to sterilise such surfaces and means are provided for controlling the supply of said vapour mixture to the enclosure in accordance with conditions determined in the enclosure; wherein means are provided for monitoring gas temperature in or exiting the enclosure or entering the preparation region, means are provided for monitoring the condensation of the decontaminant gas in or exiting the enclosure or entering the preparation region; and said means for controlling the dispensing of the decontaminant gas/water vapour into the gas in the preparation region are controlled in response to the levels determined by said monitoring to provide a predetermined level of condensation of the decontaminant gas/water vapour in the enclosure.

PATENT COOPERATION TREATY

PCT

14

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
53034/001		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/02137	02/06/2000	04/06/1999
International Patent Classification (IPC) or national classification and IPC A61L2/20		
Applicant BIOQUELL UK LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 9 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☒ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
17/11/2000	10.10.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Semino, D Telephone No. +49 89 2399 7324

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/02137

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

5-9	as originally filed			
1-4,4a	as received on	30/07/2001	with letter of	27/07/2001

Claims, No.:

1-12	as received on	30/07/2001	with letter of	27/07/2001

Drawings, sheets:

1/1	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)
   see separate sheet

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	2-6
	No:	Claims	1,7-12
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-12
Industrial applicability (IA)	Yes:	Claims	1-12
	No:	Claims	

2. Citations and explanations
   see separate sheet

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

   see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item I
Basis of the report

1. The following amendments have been considered to go beyond the disclosure as filed (Article 34(2)(b) PCT):

a. the addition of the word 'carrier' to define the gas on line 4 of claim 1, since no basis for such a wording can be found in the original application (a basis can be found only for specific gases);

b. the expression 'decontaminant gas/water vapour mixture' since it can have both the meaning 'a mixture of a decontaminant gas and water vapour' and 'a vapour mixture of decontaminant gas and water', leading in both cases to unclarity problems (see also Item VIII below);

c. the addition of the expression 'and controlling the introduction of said vapour mixture in accordance with conditions determined in the enclosure' on lines 12-14 of claim 1 and of the corresponding expression on lines 30-32 of claim 7, since no basis can be found in the original application concerning the possibility of controlling in accordance with **any** conditions in the enclosure, but only according to specific measurements and specific variables.

2. Since most of the amendments of the independent claims are not allowable and/or unclear, the present report has been established for the original claims as filed.

Re Item V and VIII

1. Independent claims 1 and 7 do not satisfy the requirements of Article 6 PCT as to clarity for the following reasons:

i. it is not clear what is intended by '**the** gas' (claim 1, l. 4), no gas being previously mentioned, and if and how it differs from 'a decontaminant gas' (l. 6);

ii. it is not clear what is meant by 'a decontaminant gas' in the whole context of claim 1, no **condensation of a gas** being possible by means of temperature variation (only a vapour can condense in such conditions);

iii. following the two points above, it is not clear which is the composition of the flowrate fed to the sealed enclosure and whether the mentioned 'dew point' (l. 7) refers to the dew point of water or of a vapour mixture;

iv. it is not clear which are the features of the 'preparation region' (cf. l. 5), which

could make it distinguishable from any feed conduit for the sterilising composition;

v. as far as claim 7 is concerned and in additions to the objections under points i-iv, it must be considered that a novel use of a known apparatus cannot make the apparatus novel as long as the known apparatus is **suitable** for the novel use; as a case in point, it can be noted that the limitation on lines 20-24 does not add anything to the means for dispensing water vapour, any such means being suitable to provide a concentration above a desired dew point.

2. As long as the sterilising mixture is intended to comprise a mixture of vapours of hydrogen peroxide and water and the preparation region is intended as a feed conduit including a vaporiser, the method of claim 1 is anticipated by the disclosure of D1 (US-A-4952370), which describes (cf. claim 1 and figures) a process for the sterilisation of surfaces within a closed chamber comprising the steps of introducing a vapour phase containing hydrogen peroxide and water in the chamber, contacting the surfaces with the vapour phase so as to effect condensation and applying a source of vacuum while continuing to introduce the vapour phase until sterilisation is completed. Moreover, the temperature is monitored so as to maintain the surfaces at desired values and the pressure is monitored as well and controlled by the source of vacuum (control of temperature and pressure is equivalent to control of the desired level of condensation that takes place in the chamber).
The method of claim 1 is therefore not novel (Article 33(2) PCT).

3. The apparatus of claim 7 is similarly not novel (Article 33(2) PCT), since it is anticipated by D1 (a valve is a means for controlling the dispensing of a flowrate and pressure and temperature measurements are means for monitoring temperature and degree of condensation, cf. also par. 1.v).
Further the apparatus of claim 7 is also anticipated by the apparatuses disclosed in D2 (EP-B-0486623, cited in the application, cf. claims 1-4 and Figure 1) and D3 (GB-A-2308066, cited in the application, cf. claim 1 and Figure 1), where, despite of the fact that condensation is not desired, all apparatus features necessary to monitor and control condensation and to feed and treat the sterilising composition are present (cf. par. 1.v).

4.1 The apparatuses of dependent claims 8-12 are also not novel (Article 33(2) PCT),

the additional features being disclosed in at least one of D1-D3.

4.2 Dependent claims 2-6 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step (Article 33(3) PCT), the additional features being common in the field.

5. The application does not fulfill the requirements of Article 6 PCT also for the following reasons:

i. the objection under paragraph 1.ii also applies to claims 5 and 11;

ii. the wording of claim 11 (cf. 'formulating (?) supply' and repetition of the expression 'after a sufficient amount ...') is such as to make it unclear which are the additional apparatus features, which are claimed;

iii. it is not clear what is meant by the sentence on page 4, l. 13-16, i.e. what is a 'correct vapour pressure characteristic' and which components can be defined by such an expression; moreover, it is not clear from the whole of the description where the hydrogen peroxide is inserted into the sterilising apparatus.

Re Item VI

Certain published documents (Rule 70.10)

Application No Patent No	Publication date *(day/month/year)*	Filing date *(day/month/year)*	Priority date *(valid claim)* *(day/month/year)*
WO-A-9930747	24.06.1999	10.12.1998	12.12.1997

IMPROVEMENTS IN OR RELATING TO A METHOD OF STERILIZING A SEALED ENCLOSURE

The present invention relates to decontamination and sterilisation systems and more particularly to the control of gaseous decontamination and systems where the vapour has more than one component.

Conventional gas sterilisation and decontamination systems have been designed in order to avoid condensation, and as such both flow through and recirculating systems have been so organised as to keep the vapour concentrations, especially of water, below the dew point. Examples of such systems are described in European Patent EP0486623B1, UK Patent 2 217 619 B, WO 89/06140 and UK Patent application GB 2308 066 A.

US-A-4952370 A discloses a method for sterilizing the interior of a chamber using hydrogen peroxide in which a first portion of the surfaces within the chamber is at a temperature below 10°C and a second portion of the surfaces is at a temperature greater than 10°C. The process includes the step of introducing vapour phase hydrogen peroxide to the chamber, contacting the first portion with the vapour to effect condensation thereon, contacting the second portion with the vapour, applying a source of vacuum to the chamber and continuing to introduce vapour phase hydrogen peroxide into the chamber until the surfaces are sterile whilst preserving the temperature ranges of the first and second portions.

More recent work has shown that for rapid surface sterilisation and decontamination in rooms and smaller chambers, or isolators, condensation of a mixture of vapours of a gaseous decontaminant such as hydrogen

peroxide and water is essential.

The object of the present invention is to control the sterilisation and decontamination systems both for closed recirculating systems, flow through systems and systems which use recirculation with a proportion of the recirculation air or air/gas mixture being exhausted from the closed system so that condensation may occur rapidly, evenly and controllable through the area to be sterilised or decontaminated.

For the purpose of this patent the term decontaminate shall in future include both chemical and microbiological decontamination. Microbiological decontamination shall mean the reduction of the viable bioburden, which is generally described either as sterilisation, sanitation or disinfection.

This invention provides method of sterilizing a sealed enclosure comprising the steps of circulating a carrier gas through the enclosure and through a preparation region, dispensing a decontaminant gas/water vapour mixture into the circulating gas in the preparation region to flow therewith through the enclosure to reach a concentration in the enclosure above the dew point of the gas/water vapour mixture for the ambient temperature in the chamber and thereby to condense onto surfaces in the enclosure to sterilise such surfaces and controlling the introduction of said vapour mixture in accordance with conditions determined in the enclosure; wherein the gas temperature in or exiting the enclosure or entering the preparation region, decontaminant gas concentration in or exiting the enclosure or entering the preparation region and condensation of the decontaminant gas in the enclosure are monitored, and the dispensing of the decontaminant gas/water vapour into the gas in the

preparation region is controlled in response to the levels determined by said monitoring to provide a requisite level of condensation of the decontaminant gas/water vapour in the enclosure.

The term "sealed enclosure" shall include any chamber or room that may for practical purposes be sealed so as to prevent the escape of such amounts of active gas as to cause a hazard.

The sealed enclosure is connected to a means of processing by two pipes through which air or a mixture of air and gases, where the gases are hydrogen peroxide and water vapour, may circulate. The air or mixture of air and gases being delivered from the means of processing to the sealed enclosure to then be returned to the processing means or alternatively a flow through system where the air or air/gas mixture is vented from the sealed enclosure in a safe manner. The air or mixture of air and gases on entering the means of processing may, if necessary, first pass through a system of purification to remove and make safe any gases within the mixture of air and gases. This purification process will not normally be required because of the stability of the gas mixture. Hydrogen peroxide gas has been shown to be stable in the homogenous vapour phase at ambient and temperatures below 300°C. Decomposition will occur on surfaces but only at insignificant rates on those surfaces generally found in clean rooms and isolators. High rates of decomposition will occur on certain organic substances such as micro-organisms but as the quantity of these materials is very small the total amount of decomposition is also very small, and hence does not significantly affect the gas concentration. A fan or pump or compressor is then used

to propel the air or mixture of air and gases around the system, and drive the fluid through the evaporation chamber where additional gases are added to the air or air gas mixture. The enriched air/gas mixture is then passed through the connection from the processing means to the sealed chamber.

The function of the air/gas mixture in the sealed chamber is to decontaminate the surfaces of the chamber.

Similar systems have been employed for some time for the surface sterilisation of sealed enclosures, but in these applications it has always been considered important to avoid condensation, Patent EP 0 486 623 B1 specifically sets out a table of operation to avoid condensation. The present invention sets out a method of decontamination by micro condensation and provides for a method of control. It has been established that faster and more reliable surface decontamination may be achieved if micro condensation is encouraged and controlled. The dew point of any hydrogen peroxide and water vapour mixture may be ascertained from the activity coefficients for the gases, and by using a combination of dew point data, the actual dew point within the sealed chamber and the temperature it is possible to calculate the concentration of hydrogen peroxide in the condensate.

A knowledge of the condensation parameters, and the amount of condensation allows a prediction of the time at which surface decontamination will occur. For such a system to function reliably it is also essential that there is very good distribution of gas within the sealed enclosure.

The active gas in such micro-condensation systems used for decontamination is not limited to hydrogen peroxide but includes a gas or mixture of gases that exhibits the correct vapour pressure characteristics.

The invention also provides a apparatus for sterilizing a sealed enclosure comprising means for circulating a gas through a preparation region and through the enclosure and means in the preparation region for dispensing a decontaminant gas and water vapour mixture into the circulating gas to flow therewith through the enclosure to reach a concentration in the enclosure above the dew point for the ambient temperature in the chamber and thereby to condense onto surfaces in the enclosure to sterilise such surfaces and means are provided for controlling the supply of said vapour mixture to the enclosure in accordance with conditions determined in the enclosure; wherein means are provided for monitoring gas temperature in or exiting the enclosure or entering the preparation region, means are provided for monitoring the condensation of the decontaminant gas in or exiting the enclosure or entering the preparation region; and said means for controlling the dispensing of the decontaminant gas/water vapour into the gas in the preparation region are controlled in response to the levels determined by said monitoring to provide a predetermined level of condensation of the decontaminant gas/water vapour in the enclosure.

CLAIMS

1. A method of sterilizing a sealed enclosure comprising the steps of circulating a carrier gas through the enclosure and through a preparation region, dispensing a decontaminant gas/water vapour mixture into the circulating gas in the preparation region to flow therewith through the enclosure to reach a concentration in the enclosure above the dew point of the gas/water vapour mixture for the ambient temperature in the chamber and thereby to condense onto surfaces in the enclosure to sterilise such surfaces and controlling the introduction of said vapour mixture in accordance with conditions determined in the enclosure; characterised in that the gas temperature in or exiting the enclosure or entering the preparation region, decontaminant gas concentration in or exiting the enclosure or entering the preparation region and condensation of the decontaminant gas in the enclosure are monitored, and the dispensing of the decontaminant gas/water vapour into the gas in the preparation region is controlled in response to the levels determined by said monitoring to provide a requisite level of condensation of the decontaminant gas/water vapour in the enclosure.

2. A method of sterilizing a sealed enclosure as claimed in claim 1, characterised in that the gas circulated through the enclosure is air.

3. A method as claimed in claim 1 or claim 2, the gas is filtered in said preparation region prior to circulation through the enclosure.

4. A method of sterilizing a sealed enclosure as claimed in any of the preceding claims, means are provided to monitor the gas pressure in the enclosure and means are provided to adjust the gas pressure

therein by controlling the supply of gas circulating through the enclosure.

5. A method as claimed in any of the preceding claims, after a sufficient amount of decontaminant gas has been condensed in the chamber to achieve decontamination, supply of the decontaminant gas and water vapour mixture to the preparation region is terminated and the decontaminant gas is removed from the sealed enclosure.

6. A method of sterilizing a sealed enclosure as claimed in claim 5, the method of removing the decontaminant gas from the sealed enclosure comprises the step of passing clean filtered gas through the enclosure and releasing the gas exiting the enclosure to atmosphere, or by circulating the gas exiting the enclosure through an auxiliary circuit containing a catalytic decomposition device or absorption device for the decontaminant gas to remove the decontaminant gas.

7. An apparatus for sterilizing a sealed enclosure comprising means (8) for circulating a gas through a preparation region (3) and through the enclosure (1) means (10) in the preparation region for dispensing a decontaminant gas and water vapour mixture into the circulating gas to flow therewith through the enclosure to reach a concentration in the enclosure above the dew point for the ambient temperature in the chamber and thereby to condense onto surfaces in the enclosure to sterilise such surfaces and means (19) for controlling the supply of said vapour mixture to the enclosure in accordance with conditions determined in the enclosure; characterised in that means (15) are provided for monitoring gas temperature in or exiting the enclosure or entering the preparation region, means (17, 18) are provided for monitoring the condensation of the decontaminant gas in or exiting the enclosure or

entering the preparation region and said means (19) for controlling the dispensing of the decontaminant gas/water vapour into the gas in the preparation region are controlled in response to the levels determined by said monitoring to provide a predetermined level of condensation of the decontaminant gas/water vapour in the enclosure.

8. An apparatus as claimed in claim 7, characterised in that means (8) are provided for circulaing air through the preparation region and enclosure to convey the decontaminant gas/water vapour mixture to the enclosure.

9. An apparatus as claimed in claim 7 or claim 8, means (25) are provided for filtering the gas in said preparation region (3) prior to circulation through the enclosure.

10. An apparatus as claimed in any of claims 7 to 9, means (16) are provided to monitor the gas pressure in the enclosure (1) and means (21, 23, 24) are provided to adjust the gas pressure therein by controlling the supply of gas circulating through the enclosure.

11. An apparatus as claimed in any of claims 7 to 10, wherein the control (19) means are arranged to terminate supply of the decontaminant gas and water vapour mixture in the preparation region after a sufficient amount of decontaminant gas has condensed in the enclosure to achieve decontamination and for removing the decontaminant gas from the enclosure.

12. An apparatus as claimed in claim 11, characterised in that the means for removing the decontaminant gas from the sealed enclosure comprises means (4, 5) for passing clean filtered gas through the enclosure and

releasing the gas exiting the enclosure to atmosphere, or means for circulating the gas exiting the enclosure through an auxiliary circuit containing a catalytic decomposition device or absorption device for the decontaminant gas to remove the decontaminant gas.

INTERNATIONAL SEARCH REPORT

In. ational Application No
PCT/GB 00/02137

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61L2/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 99 30747 A (ROSSI & CATELLI SPA ;MUSATTI MARCO (IT); CATELLI CAMILLO (IT)) 24 June 1999 (1999-06-24) page 6, line 11 -page 10, line 2	1-12
A	US 4 952 370 A (CUMMINGS ARTHUR L ET AL) 28 August 1990 (1990-08-28) column 2, line 41 - line 64	1,7
A	DE 44 27 577 A (KRONSEDER MASCHF KRONES) 8 February 1996 (1996-02-08) abstract	1,7

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 September 2000	19/09/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Diederen, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

In tional Application No
PCT/GB 00/02137

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9930747 A	24-06-1999	DE 19808318 A	02-09-1999
		IT M0970225 A	14-06-1999
		AU 1031999 A	15-09-1999
		AU 1782299 A	05-07-1999
		WO 9943607 A	02-09-1999
US 4952370 A	28-08-1990	CA 1318479 A	01-06-1993
		DE 68908857 D	07-10-1993
		DE 68908857 T	20-01-1994
		EP 0373201 A	20-06-1990
		JP 2750764 B	13-05-1998
		JP 3500017 T	10-01-1991
		WO 8910762 A	16-11-1989
DE 4427577 A	08-02-1996	NONE	

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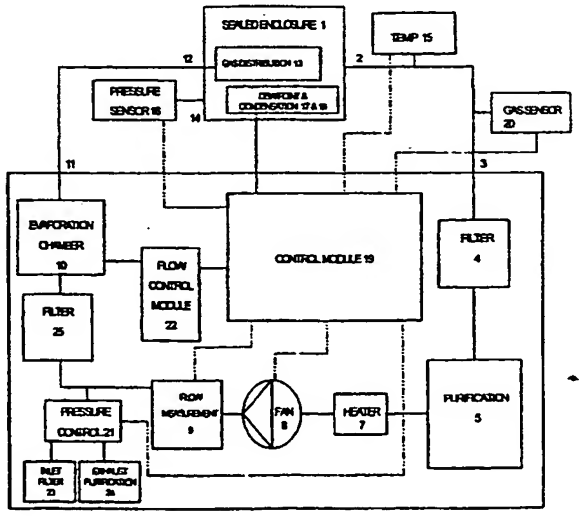
Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SEALED ENCLOSURE STERILIZATION



(57) Abstract: The disclosure relates to an apparatus for sterilizing a sealed enclosure (1) comprising a fan (8) for circulating a gas through a preparation circuit (11) and through the enclosure. The preparation circuit includes an evaporation chamber (10) for dispensing a decontaminant gas and water vapour mixture into the circulating gas to flow therewith through the enclosure and to reach a concentration in the enclosure above the dew point for the ambient temperature in the enclosure and thereby to condense onto surfaces in the enclosure to sterilise such surfaces. A monitor (15) measures gas temperature and dew point/condensation are monitored (17, 18) in the enclosure and the resulting signals led to a control module (19) for controlling the rate of dispensing of the decontaminant gas and water vapour into the gas in the preparation circuit in response to the levels determined by said monitoring to provide a required level of condensation of the decontaminant gas and water vapour in the enclosure.

WO 00/74734 A1

SEALED ENCLOSURE STERILIZATION

The present invention relates to decontamination and sterilisation systems and more particularly to the control of gaseous decontamination and systems where the vapour has more than one component.

Conventional gas sterilisation and decontamination systems have been designed in order to avoid condensation, and as such both flow through and recirculating systems have been so organised as to keep the vapour concentrations, especially of water, below the dew point. Examples of such systems are described in European Patent EP0486623B1, UK Patent 2 217 619 B, WO 89/06140 and UK Patent application GB 2308 066 A.

More recent work has shown that for rapid surface sterilisation and decontamination in rooms and smaller chambers, or isolators, condensation of a mixture of vapours of a gaseous decontaminant such as hydrogen peroxide and water is essential.

The object of the present invention is to control the sterilisation and decontamination systems both for closed recirculating systems, flow through systems and systems which use recirculation with a proportion of the recirculation air or air/gas mixture being exhausted from the closed system so that condensation may occur rapidly, evenly and controllable through the area to be sterilised or decontaminated.

For the purpose of this patent the term decontaminate shall in future include both chemical and microbiological decontamination. Microbiological decontamination shall mean the reduction of the viable

bioburden, which is generally described either as sterilisation, sanitation or disinfection.

This invention provides a method of sterilizing a sealed enclosure comprising the steps of: circulating the gas through the enclosure, and through a preparation region, in the preparation region dispensing a decontaminant gas and water vapour mixture into the circulating gas to flow therewith through the enclosure to reach a concentration in the enclosure above the dew point for the ambient temperature in the chamber and thereby to condense onto surfaces in the enclosure to sterilise such surfaces; wherein the gas temperature and the condensation of the decontaminant gas in the enclosure are monitored and the dispensing of the decontaminant gas and water vapour into the gas in the preparation region is controlled in response to the levels determined by said monitoring to provide a requisite level of condensation of the decontaminant gas/water vapour in the enclosure.

The term "sealed enclosure" shall include any chamber or room that may for practical purposes be sealed so as to prevent the escape of such amounts of active gas as to cause a hazard.

The sealed enclosure is connected to a means of processing by two pipes through which air or a mixture of air and gases, where the gases are hydrogen peroxide and water vapour, may circulate. The air or mixture of air and gases being delivered from the means of processing to the sealed enclosure to then be returned to the processing means or alternatively a flow through system where the air or air/gas mixture is vented from the sealed enclosure in a safe manner. The air or mixture of air and gases on entering the means of processing may, if necessary, first pass through a

system of purification to remove and make safe any gases within the mixture of air and gases. This purification process will not normally be required because of the stability of the gas mixture. Hydrogen peroxide gas has been shown to be stable in the homogenous vapour phase at ambient and temperatures below 300°C. Decomposition will occur on surfaces but only at insignificant rates on those surfaces generally found in clean rooms and isolators. High rates of decomposition will occur on certain organic substances such as micro-organisms but as the quantity of these materials is very small the total amount of decomposition is also very small, and hence does not significantly affect the gas concentration. A fan or pump or compressor is then used to propel the air or mixture of air and gases around the system, and drive the fluid through the evaporation chamber where additional gases are added to the air or air gas mixture. The enriched air/gas mixture is then passed through the connection from the processing means to the sealed chamber.

The function of the air/gas mixture in the sealed chamber is to decontaminate the surfaces of the chamber.

Similar systems have been employed for some time for the surface sterilisation of sealed enclosures, but in these applications it has always been considered important to avoid condensation, Patent EP 0 486 623 B1 specifically sets out a table of operation to avoid condensation. The present invention sets out a method of decontamination by micro condensation and provides for a method of control. It has been established that faster and more reliable surface decontamination may be achieved if micro condensation is encouraged and controlled. The dew point of any hydrogen peroxide and water vapour mixture may be ascertained from the activity coefficients for the gases, and by using a

combination of dew point data, the actual dew point within the sealed chamber and the temperature it is possible to calculate the concentration of hydrogen peroxide in the condensate.

A knowledge of the condensation parameters, and the amount of condensation allows a prediction of the time at which surface decontamination will occur. For such a system to function reliably it is also essential that there is very good distribution of gas within the sealed enclosure.

The active gas in such micro-condensation systems used for decontamination is not limited to hydrogen peroxide but includes a gas or mixture of gases that exhibits the correct vapour pressure characteristics.

The invention also provides an apparatus for sterilizing a sealed enclosure comprising means for circulating a gas through a preparation region and through the enclosure and means in the preparation region for dispensing a decontaminant gas and water vapour mixture into the circulating gas to flow therewith through the enclosure to reach a concentration in the enclosure above the dew point for the ambient temperature in the chamber and thereby to condense onto surfaces in the enclosure to sterilise such surfaces; wherein means are provided for monitoring the temperature and the concentration of the decontaminant gas in the enclosure and means are provided for controlling the rate of dispensing of the decontaminant gas and water vapour into the gas in the preparation region in response to the levels determined by said monitoring to provide a predetermined rate of condensation of the decontaminant gas and water vapour in the enclosure.

The following is a description of one embodiment of the invention, reference being made to the accompanying drawing which is a diagrammatic illustration of a decontamination apparatus for a sealed enclosure.

The sealed enclosure 1 is connected to a sealed outlet pipe at 2 which connects to the processing means at 3. The air or air/gas mixture then passes through a filter 4 to remove particulate contamination. As an option if it is considered that the gas mixtures may have partially decomposed in the sealed chamber the air or air/gas mixture may be passed through a purification process 5. Step 5 is only required in exceptional circumstances when significant decomposition of the active gas has taken place. This component would not normally form part of the processing means. The air or air/gas mixture should then be heated in 7 to bring it to a stable temperature before passing to the fan or pump or compressor 8 which is used to drive the air or air/gas mixture through the processing means, the connecting pipes and the sealed enclosure. The volumetric flow is then measured in 9 before the air or air gas mixture is passed to the evaporation chamber 10 where more of the gas mixture is added by evaporation of the decontamination solution on a hot surface. The air or air /gas mixture passes through a filter 25 before entering the evaporation chamber 10 to ensure that particulate matter is removed from the flow. The rate at which the liquid is fed to the evaporation chamber 10 is controlled by the Liquid Flow Module 22.

Because it may be necessary to control the pressure inside the sealed enclosure a pressure control module 21 is used to raise or lower the pressure by supply or extracting air. Any air added to the system must be filtered 23 and any air extracted must be rendered safe by the removal of any active gas either by absorbing the

gas or by decomposition with a catalyst 24. The air or air/gas mixture leaves the processing means at 11 through a sealed connecting pipe and is delivered to the sealed enclosure at 12. Within the sealed enclosure is a gas distribution device 13 which generates sufficient turbulence in the air or air/gas mixture within the sealed enclosure to ensure rapid and even distribution of the air or air/gas mixture.

The gas distribution system in the simplest form would be a circulating fan mounted inside the sealed enclosure which generated sufficient turbulence in the air gas mixture to generate an even distribution of gas. A more affective technique would be to use a nozzle rotating about two axles at right angles directing a jet of gas as it is delivered to the chamber at high velocity over a fixed pattern. The use of such a rotating nozzle has the advantage of generating repeating patterns over the internal surface of the sealed chamber. It also allows the air/gas mixture to be delivered at an optimum temperature from a heated pipe 11 to 12 and by correct design of the nozzle allows the delivered gas velocity to be adjusted to suit the geometry of the chamber.

A pressure sensing point 14 on the sealed enclosure is connected by a sealed tube to the pressure sensing device at 16. The signal from the pressure sensor is transmitted to the control module 19 which in turn sends signals to the pressure control module 21 to adjust the internal pressure of the sealed enclosure. Such pressure control may be inactivated when it is not possible because of the size of construction of the sealed enclosure or when pressure control is not required. The dew point and condensation monitor 17 is connected electronically to the processing unit 18 which may be either attached to the sealed enclosure or in the processing means. The signal from the dew point and

condensation processing unit is passed to the control module and is used to control the rate of micro-condensation that occurs inside the sealed enclosure. The temperature 15 of the air or the air/gas mixture either inside the sealed enclosure, or leaving the sealed enclosure, or on entering the processing means is measured and the signal passed to the control module 19. A gas sensor 20 measures the gas concentration either inside the sealed enclosure, or on leaving the sealed enclosure, or on entering the processing means. The signal from the gas sensor is transmitted electronically to the control module 19. If the distance from the processing means to the sealed enclosure is great the pipe connecting 11 to 12 should be heated and insulated to maintain the temperature above the dew point of the air/gas mixture being delivered from the evaporation chamber.

Method of Control

As the decontamination process relies on micro-condensation on particles on the surface it is important that this process is controlled. This control is achieved with reference to the dew point and rate of condensation as measured on the dew point and condensation sensor 17 together with the temperature sensor 15 and the gas sensor 20.

After an initial stabilisation period during which the air flow and temperature are stabilised, the liquid flow module 22, under the direction of the control module 19 will start to dispense a measured flow of liquid to the evaporation chamber 10. This measure flow of liquid will be turned into a gas mixture in the evaporation chamber and mixed with a measured flow of air as measured by the flow measurement device 9 and controlled via the control module 19 by the fan or pump or

compressor 8.

This technique will provide a predetermined air gas mixture concentration which will be delivered to the sealed enclosure 1 and evenly distributed throughout the chamber by the distribution device 13. This air/gas mixture must have a concentration above the dew point for the temperature of the sealed enclosure 1. Once sufficient air/gas mixture has circulated round the system through the sealed enclosure and the processing means to raise the air/gas concentration above the dew point then the condensation will occur and be signalled by the dew point and condensation sensor 17. From a knowledge of the temperature as indicated by the temperature sensor 15 and the gas concentration as indicated by the gas sensor 20 and the dew point it is possible to derive the concentration of the sterilant in the micro-condensation. Once the dew point has been reached the rate of liquid delivered by the liquid flow module 22 to the evaporation chamber 10 will be adjusted to achieve the required rate of condensation in the sealed enclosure. After a sufficient amount of condensation has occurred as measured by the dew point and condensation sensor 17 and also by the amount of liquid delivered from the liquid flow module 22 to the evaporation chamber 10 then the liquid flow is stopped as decontamination will have been achieved. The amount of condensation in any sealed enclosure to achieve decontamination will have to be demonstrated by the use of a testing technique suitable for the containment.

Once the liquid flow from the liquid flow module 22 to the evaporation chamber 10 has been stopped then a system to remove the decontaminant gas from the sealed enclosure 1 must be operated. This may either consist of a method of passing clean filtered air through the sealed enclosure 1 and passing the air from the sealed

enclosure which will then contain active gas safely to atmosphere or by circulating the air/gas mixture through an auxiliary circuit to remove the decontaminant gas. Such an auxiliary circuit could be either a catalyst decomposition device or an absorption technique such as activated carbon. It may also be possible to use a combination of both methods, first reducing the concentration with a catalyst or activated carbon and then passing the balance safely to atmosphere.

CLAIMS

1. A method of sterilizing a sealed enclosure comprising the steps of: circulating the gas through the enclosure, and through a preparation region, in the preparation region dispensing a decontaminant gas and water vapour mixture into the circulating gas to flow therewith through the enclosure to reach a concentration in the enclosure above the dew point for the ambient temperature in the chamber and thereby to condense onto surfaces in the enclosure to sterilise such surfaces; wherein the gas temperature and the condensation of the decontaminant gas in the enclosure are monitored and the dispensing of the decontaminant gas and water vapour into the gas in the preparation region is controlled in response to the levels determined by said monitoring to provide a requisite level of condensation of the decontaminant gas/water vapour in the enclosure.

2. A method of sterilizing a sealed enclosure as claimed in claim 1, wherein the gas circulated through the enclosure is air.

3. A method as claimed in claim 1 or claim 2, wherein the gas is filtered in said preparation region prior to circulation through the enclosure.

4. A method of sterilizing a sealed enclosure as claimed in any of the preceding claims, wherein means are provided to monitor the gas pressure in the enclosure and means are provided to adjust the gas pressure therein by controlling the supply of gas circulating through the enclosure.

5. A method as claimed in any of the preceding claims, wherein after a sufficient amount of decontaminant gas has been condensed in the chamber to achieve

decontamination, supply of the decontaminant gas and water vapour mixture to the preparation region is terminated and the decontaminant gas is removed from the sealed enclosure.

6. A method of sterilizing a sealed enclosure as claimed in claim 5, wherein the method of removing the decontaminant gas from the sealed enclosure comprises the step of passing clean filtered gas through the enclosure and releasing the gas exiting the enclosure to atmosphere, or by circulating the gas exiting the enclosure through an auxiliary circuit containing a catalytic decomposition device or absorption device for the decontaminant gas to remove the decontaminant gas.

7. An apparatus for sterilizing a sealed enclosure comprising means for circulating a gas through a preparation region and through the enclosure and means in the preparation region for dispensing a decontaminant gas and water vapour mixture into the circulating gas to flow therewith through the enclosure to reach a concentration in the enclosure above the dew point for the ambient temperature in the chamber and thereby to condense onto surfaces in the enclosure to sterilise such surfaces; wherein means are provided for monitoring gas temperature and for monitoring the condensation of the decontaminant gas in the enclosure and means are provided for controlling the dispensing of the decontaminant gas/water vapour into the gas in the preparation region in response to the levels determined by said monitoring to provide a predetermined level of condensation of the decontaminant gas/water vapour in the enclosure.

8. An apparatus as claimed in claim 7, wherein means are provided for circling air through the preparation region enclosure and to convey the decontaminant

gas/water vapour mixture to the enclosure.

9. An apparatus as claimed in claim 7 or claim 8, wherein means are provided for filtering the gas 7 in said preparation region prior to circulation through the enclosure.

10. An apparatus as claimed in any of claims 7 to 9, wherein means are provided to monitor the gas pressure in the enclosure and means are provided to adjust the gas pressure therein by controlling the supply of gas circulating through the enclosure.

11. An apparatus as claimed in any of the preceding claims, wherein after a sufficient amount of decontaminant gas has been condensed in the chamber to achieve decontamination, means are provided for formulating supply of the decontaminant gas and water vapour mixture to the preparation region after a sufficient amount of decontaminant gas has been condensed in the chamber to achieve decontamination and for removing the decontaminant gas from the sealed enclosure.

12. An apparatus as claimed in claim 11, wherein the means for removing the decontaminant gas from the sealed enclosure comprises means for passing clean filtered gas through the enclosure and releasing the gas exiting the enclosure to atmosphere, or means for circulating the gas exiting the enclosure through an auxiliary circuit containing a catalytic decomposition device or absorption device for the decontaminant gas to remove the decontaminant gas.

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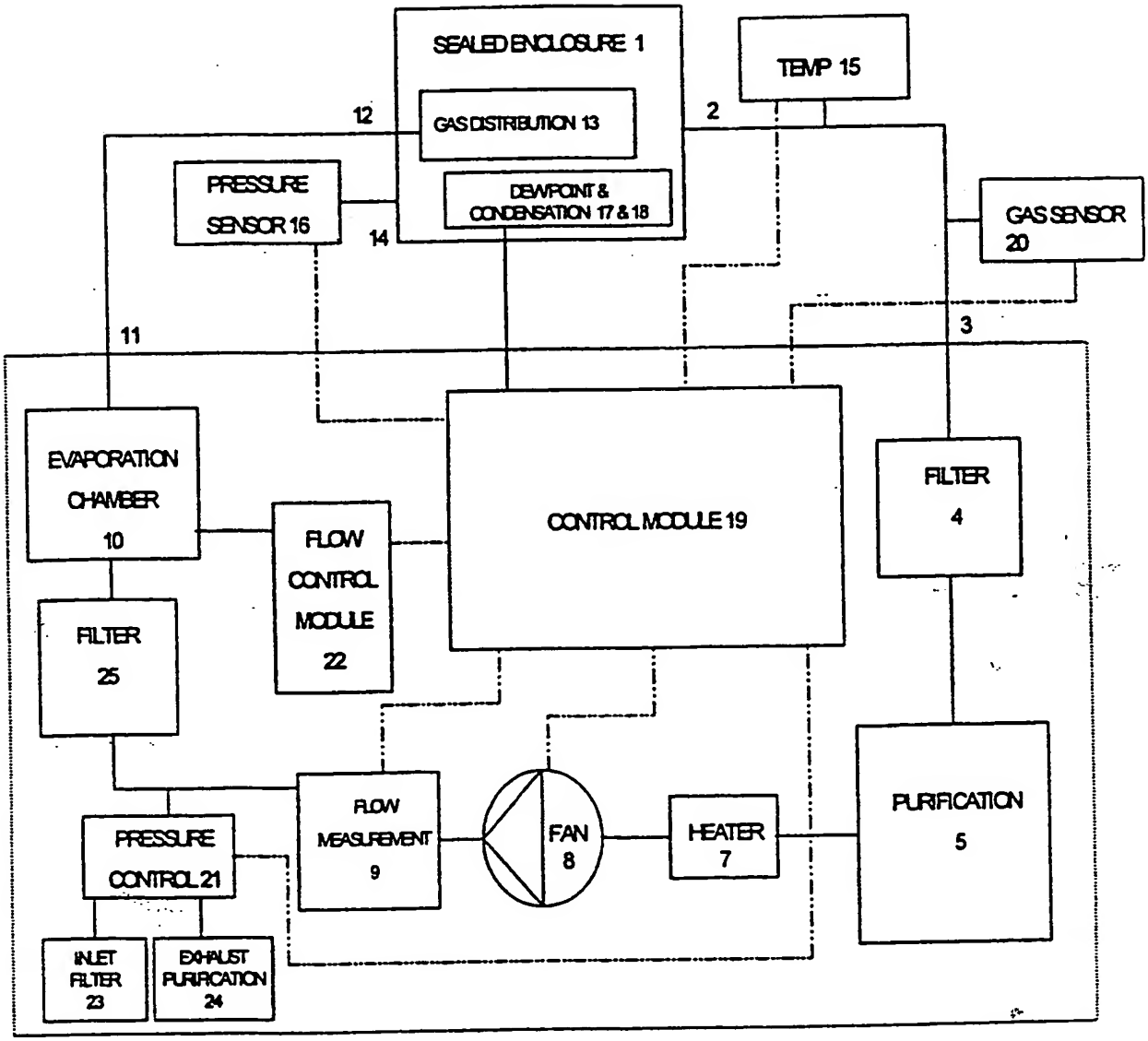
Fig 1



INTERNATIONAL SEARCH REPORT

In. ational Application No
PCT/GB 00/02137

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61L2/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	WO 99 30747 A (ROSSI & CATELLI SPA ;MUSATTI MARCO (IT); CATELLI CAMILLO (IT)) 24 June 1999 (1999-06-24) page 6, line 11 -page 10, line 2	1-12
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A	DE 44 27 577 A (KRONSEDER MASCHF KRONES) 8 February 1996 (1996-02-08) abstract	1,7

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATION. SEARCH REPORT

Information on patent family members

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